



Master in Photonics – “PHOTONICS BCN” Master ERASMUS Mundus “EuroPhotonics”

MASTER THESIS PROPOSAL

Starting full time from April 2025

Presentation at the end of July or beginning of September 2025

Laboratory: Center for Sensors, Instruments and Systems Development (CD6)

(<https://www.cd6.upc.edu/>)

Institution: Universitat Politècnica de Catalunya

City, Country: Terrassa, SPAIN

Title of the master thesis: Photonic systems for accurate spectral and 3D analysis of biological samples

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Keywords: Spectral imaging, 3D, biological samples, deep learning

Summary of the subject (maximum 1 page):

The CD6 is currently developing innovative photonic approaches capable of acquiring reliable **spectroscopic and morphological data** from biological samples. The primary focus is on applications within the fields of biomedicine and agriculture, where significant challenges and limitations persist, necessitating breakthrough solutions to provide precise systems as well as low-cost and fast tools.

Regarding the acquisition of spectroscopic information from biological samples, the goal is two-fold: (i) advancing imaging systems to precisely analyze the spectral features of skin lesions (benign and cancerous), and (ii) developing novel methods for outdoors spectral assessment of vegetation, by leveraging hyperspectral imaging technology alongside the benefits offered by novel light sources.

Besides retrieving reliable spectroscopic information from biological samples, new efficient and cost-effective methods, based on stereoscopic approaches, for the morphological characterization of skin cancer lesions and the crop canopy are also in progress aiming at developing new non-invasive diagnostic approaches and feeding integrated crop management operations, respectively.

All the former tasks are within the framework of European and a National research projects (NOVATERRA, H2020, and NASMABIO, National Plan) currently conducted by the research group involved in this proposal.

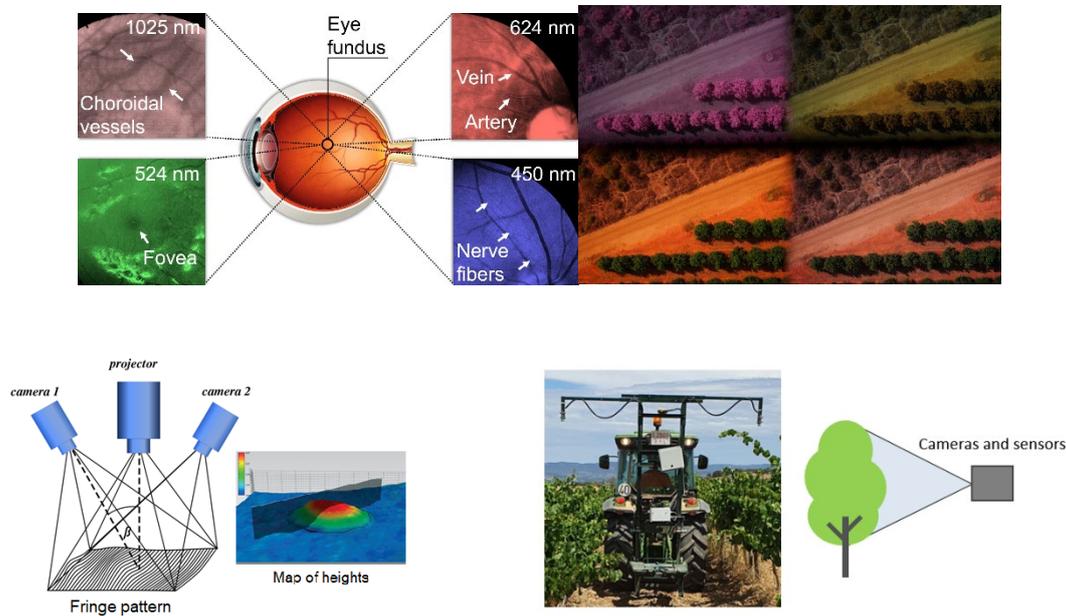


Figure. Spectroscopic and morphological analysis using multispectral and stereoscopic systems in biomedical and agricultural applications carried out at the CD6

Objectives:

The student choosing this proposal will participate in parts of the former projects. For this purpose, we look for a motivated and enthusiastic student with good team working skills to

1. Participate in the experimental implementation of spectral and 3D experimental setups for skin and vegetation characterization, in particular multispectral laser-based and stereoscopic imaging systems.
2. Develop new fast algorithms for the extraction of spectroscopic and geometrical parameters describing the skin relief and vegetation structure (reflectance, height, width) from the images.
3. Investigate the possibility of adapting existing machine and deep learning classification algorithms in the state of the art, such as convolutional neural networks (CNN), in order to classify the samples using spectral and morphological features.
4. Train and test the developed algorithms with our datasets, comparing the results with ground truth values and those obtained with other techniques.

Additional information (if needed):

It is desirable that the student has the following knowledge/skills in:

- Python and Matlab programming.

Amount of the monthly allowance:

To be discussed depending on the value of the candidate.